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ELECTRICAL HEATING RESISTANCE ELEMENT,

The present invention relates to an electrical resistance element.

Heating elements of present kind are intended for use in heat treatment and sintering processes in inert and reducing atmospheres and also oxidising atmospheres and vacuum conditions, up to extremely high temperatures, such as temperatures as high as 2300°C, but also at low temperatures, e.g. temperatures of 500°C.

Resistance elements of the present kind are manufactured by Applicants. The resistance elements are of a widely varying kind and are based on NiCr, FeCrAl, SiC and $MoSi_2$ and their alloys. These materials are used in a plurality of atmospheres and at different temperatures. Heating elements that are comprised mainly of Mo, W. Ta (tantalium) and graphite are used in respect of temperatures around and above 2000°C. In the case of lower temperatures there is used a molybdenum silicide and aluminium oxide composite.

The elements comprise one, two or more legs and include two terminals for connection to a source of electric current. The diameter of the terminals is greater than the diameter of the glow zones of the elements, so as to reduce the amount of heat generated at the terminals. The elements are in the form of homogenous rods through which electric current flows.

There is a desire to increase the electrical resistance in the glow zone of the element so as to obtain the same element temperature at a lower current strength, which would greatly lower the power supply installation costs of the elements.

The solution in which the element is given a smaller diameter and therewith a higher electrical resistance results in a smaller element radiation surface, which is highly disadvantageous since greater radiation gives a larger heat yield through radiation heat. Moreover, thin elements result in mechanical strength problems at high temperatures.

Such desiderata are fulfilled by the present invention.

Accordingly. the present invention relates to an electrical resistance element that includes a glow żone and two power supply terminals, wherein the invention is characterised in that the glow zone of the element is tubular and in that a connecting piece or union is provided between respective terminals and respective ends of the glow zone.

The invention will now be described in more detail partly with reference to an exemplifying embodiment thereof illustrated in the accompanying drawing, in which

Figure 1 illustrates a two-leg heating element, and

Figure 2 illustrates union means.

It will be understood that application of the invention is not limited to two-leg elements but that the invention can also be applied to elements that have two or more legs.

Figure 1 is a longitudinal sectioned view of a two-leg element 1.

The electrical resistance element 1 includes a glow zone 2 and two power supply terminals 3, 4.

According to the invention, the glow zone 2 of the element 1 is tubular. The Figure also shows union means 5, 6 between respective terminals 3, 4 and respective ends 7, 8 of the glow zone 2.

Because the glow zone is tubular and has an outer diameter that corresponds to the outer diameter of a corresponding typical element, the radiation surface will be the same. On the other hand, as a result of the smaller cross-sectional area a lower current strength is required through the glow zone in order to obtain the same element temperature. This lowers significantly the costs incurred by the element power supply equipment, while obtaining the same temperature and power.

The union 5, 6 will preferably also be tubular although with a greater wall thickness, which due to the lower electrical resistance will result in a lower union temperature. The same applies to the terminals 3, 4.

In order to avoid sharp temperature gradients, the union 5, 6 has a larger inner diameter at its end attached to the glow zone 2.

According to one preferred embodiment of the invention, the glow zone 2 has essentially the same inner diameter as the largest inner diameter of the union 5,6.

According to another preferred embodiment of the invention, the union 5, 6 has essentially the same outer diameter as the glow zone 2 while the wall thickness of the union decreases successively towards its end facing towards the glow zone, see Fig. 2. Figure 2 is an enlarged view of the circled area in Fig. 1.

With the intention of adapting the union to both a welding operation, in which one end of the union is welded in abutment with the end of the glow zone, and to the operation of the element, it is preferred that the successively decreasing wall thickness follows a function illustrated in Fig. 2 with respect to a number of measurements.

Thus, it is preferred that the successively decreasing wall thickness complies with the function $r = \frac{ro}{\sqrt{lo}}\sqrt{l}$, where l coincides with the longitudinal axis of the union, r corresponds to the inner radius of the union, lo corresponds to the length along which the wall thickness decreases, and ro corresponds to the largest inner radius of the union.

The largest inner radius of the union is typically 3 – 5 times larger than its smallest inner radius.

It is also preferred that respective union 5, 6 and respective terminals 3,4 together form a one-piece structure.

The resistance elements are produced in different dimensions, for instance with an outer diameter of 9, 12 and 16 mm. The union dimensions and the glow zone dimensions will, of course, be adapted to each other, for instance in accordance with the above formula.

Typical element proportions may be such that in the case of an element with a glow zone that has an outer diameter of about 12 mm its inner diameter will be about 10 mm while the union will have an outer diameter of about 12 mm and a smallest inner diameter of about 3 mm while the successively decreasing wall thickness of the union will extend through a distance of about 16 mm.

The inventive element may be produced from all sorts of material that are produced by Applicants, among others, for a number of different applications. Thus, application of the invention is not limited to high temperature elements, but can be applied equally as well for low temperature applications.

The wall thickness of the glow zone may have dimensions other than those given above, depending on the application concerned among other things.

The transition between union and glow zone may have a different form, although while ensuring that sharp temperature gradients and therewith thermostresses are avoided.

The present invention shall not therefore be considered limited to the above described embodiment, since variations can be made within the scope of the accompanying claims.